NORTHERN SPOTTED OWL MONITORING
ANNUAL REPORT, FY 2009 26 February 2010

1. **Title**:

   Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) in the Klamath Mountain Province of Oregon, 1985-2009.

2. **Principal Investigators and Organizations**:

   Ray Davis (Interim Principal Investigator); R. Horn (Lead Biologist); Biologists: P. Caldwell, S. Cross, R. Crutchley , K. Fukuda, C. Larson, J. Lowden, M. O'Hara, J. Stegmeier, H. Wise.

3. **Study Objectives**:

   The study objectives are to estimate the population parameters of northern spotted owls on the Klamath Study Area (KSA) within the Klamath Mountain Province. These parameters include occupancy, survival and reproductive success. The lands are administered by the Glendale and South River Field Office of the Medford and Roseburg Districts of the USDI Bureau of Land Management (BLM).

4. **Potential Benefit or Utility of the Study**:

   The KSA is one of 8 long-term northern spotted owl study areas designed to assess trends in spotted owl populations and habitat as directed under the Northwest Forest Plan (USDA and USDI 1994). The data from these studies were recently analyzed as part of a rangewide meta-analysis workshop (Forsman et al. in press). The survival and reproductive data will be used in population modeling to assess the long-term stability of the population (Franklin et al. 1999). Data from several study areas will be used in the development of habitat predictive models for the spotted owl (Lint et al. 1999, Anthony et al. 2000).

5. **Study Area Description and Survey Design**:

   The KSA is located within the Klamath Mountains Province in SW Oregon and is approximately 1422 km^2 (351,334 ac) in size (Figure 1). This province is characterized by mixed conifer forests dominated by Douglas-fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*). Other species common include pine (*Pinus* spp.), grand fir (*Abies grandis*), pacific madrone (*Arbutus menziesii*), golden chinquapin (*Castanopsis chrysophylla*), and oak (*Quercus* spp.) (Franklin and Dyrness 1973). Sites within the current boundaries of the KSA were systematically surveyed from 1997-present. A smaller study area (about 466 km^2; 115,138 ac) was systematically surveyed from 1990-1994 and is encompassed within the current boundaries.

   The KSA includes portions of 2 BLM Districts in Western Oregon (Medford and

Roseburg), and much of the intervening areas of private and state lands. The federal lands are primarily in an alternating "checkerboard" pattern of ownership with private lands. Of the 8 long-term studies, 2 of them (Klamath and Tyee) are composed almost entirely of this checkerboard pattern of ownership. Two types of study areas are included in the 8 long-term studies, density study areas where all of the area within the boundary is surveyed each year, and territorial study areas where all known past and present owl territories are surveyed each year. The KSA is a territory based study area.

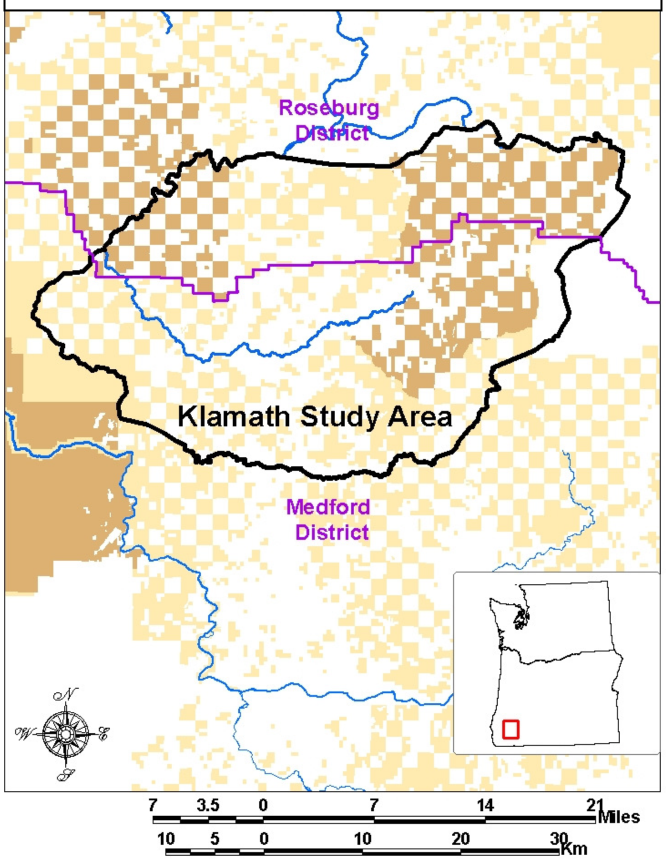


Figure 1. Klamath Study Area boundary. Tan and brown represent federally administered lands, brown represents LSR.

The Northwest Forest Plan (NWFP) designates forestland into several Land Use Allocations (LUA's). One such LUA is designated Late Successional Reserve (LSR) and is designed to provide a functional late-successional and old growth forest ecosystem. The KSA includes part or all of 2 LSR areas designated under the NWFP.

The checkerboard pattern makes analysis by ownership or LUA difficult as virtually all sites within an LSR designation also encompass non-LSR within their home range. For the purpose of this analysis, a line was drawn around each of the 2 LSR's in the study. If sites were located within these boundaries they were considered in LSR, even though the private land within these boundaries is not actually designated as LSR.

The study monitors demographic parameters including survival rates, reproductive rates, and annual rate of population change. The protocol currently used to determine site occupancy, nesting, and reproductive status for this study follows the guidelines specified by the Northern Spotted Owl Effectiveness Monitoring Plan for the Northwest Forest Plan (Lint et al. 1999). An attempt is made to uniquely color band or reobserve all previously banded individuals within the study. The reobservation of banded owls will be used for the calculation of survival rates and population trends (Franklin et al. 1999, Burnham et al. 1996, Anthony et al. 2006, Forsman et al. in press).

6. Results for FY 2009:

Survey Effort

There are currently 156 known spotted owl sites within the KSA. During the period of study, it was determined that 4 sites that were considered separate sites were different use areas of another site and have been combined. Of the 156 sites surveyed during 2009; 75 were occupied by a pair, 9 by a single, and 14 were occupied by 1 or 2 owls with unknown status (Appendix A). At least one spotted owl was detected at 98 (62.8 %) of the sites. No new sites were documented within the study during 2009, and only 1 site was added since 2007. Consistent occupancy by a territorial single or a pair is the usual criteria for designating a new site.

Spotted Owl Detections and Banding by Sex and Age

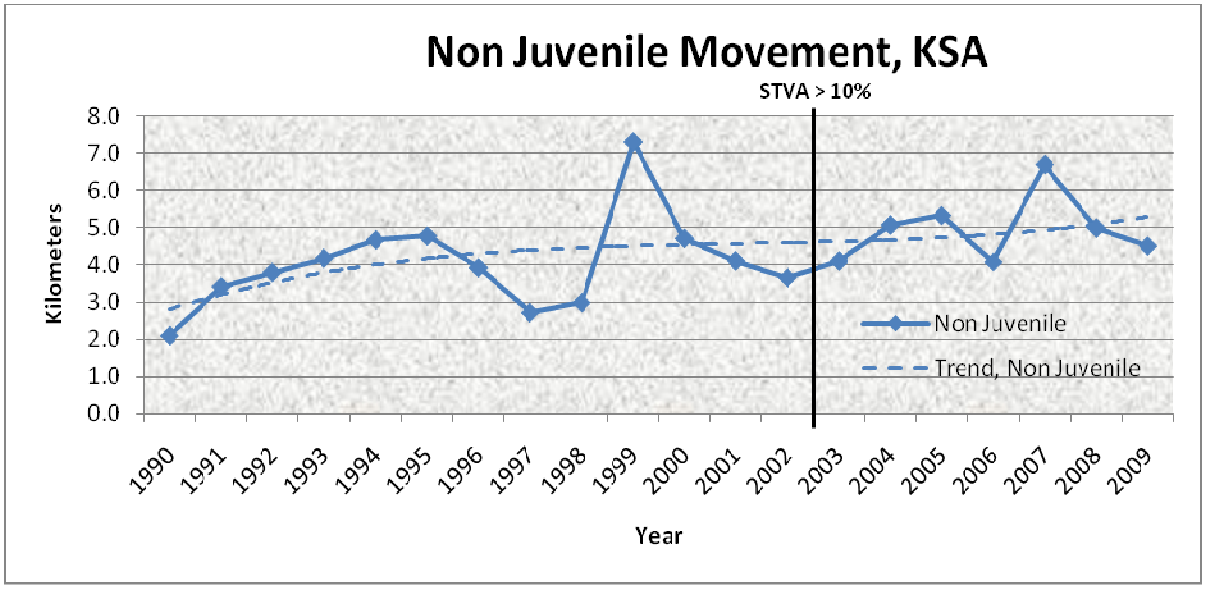
A total of 169 non-juvenile spotted owls were detected on the KSA during 2009, of which 92 were males and 77 were females, resulting in a male:female sex ratio for non-juveniles of 1.19:1. Of the 155 non-juvenile owls on the KSA where age was determined, 147 (94.8%) were adults and 8 (5.2%) were subadults (Appendix B). The oldest known owl within the KSA was a male that was at least 21 years old. The oldest known female was at least 16 years old. A total of 40 owls were newly banded on the KSA during 2009. Of these, 33 (82.5%) were fledglings, 3 (7.5%) were adults, and 4 (10.0%) were subadults.

During 2009, of the 17 owls encountered for the first time as non-juveniles on the study, the ages of 14 (82.3%) were known exactly or within 1 year. On the KSA during 2009, no non-juvenile was a known immigrant and 2 non-juveniles were known emigrants. A total of 13 owls originally banded as juveniles within the KSA were recaptured during 2009, 9 of which were recaptured within the KSA. The longest distance moved for a juvenile banded within the study and relocated during 2009 was 23.0 km (14.3 mi) from the point of original banding, and the longest distance moved for a non-juvenile banded within the study and relocated during 2009 was 15.5 km (9.6 mi) from the point of previous confirmation. The average distance for recoveries of dispersing males during 2009 was 9.1 km (5.6 mi) (N=7) and for females was 23.0 km (14.3 mi) (N=6). The average distance for movements of non-juvenile males during 2009 was 3.2 km (2.0 mi) (N=10) and for females was 5.4 km (3.4 mi) (N=7). The average distance of non-juvenile movements has been trending upward (Figure 2).

Spotted Owl Reproduction

Yearly reproductive data (1985-2009) (Appendix C) includes nest success, fecundity rate, and mean brood size. The proportion of females nesting is defined as the number of females that attempted to nest compared to the total where nesting status was determined. Nest success is defined as the proportion of nesting females that fledged young. The fecundity rate is defined as the number of female young produced per female where the number of young produced was determined. The mean brood size is defined as the average number of young produced per successfully reproducing pair. Where appropriate, the data were split into 4 female age classes; 1-year old, 2-year old, adult, and unknown age. The reproductive data were analyzed 2 ways: 1) the entire KSA, and 2) divided into 2 groups (LSR and non-LSR) (Appendix D).

Figure 2. The annual average distance of non-juvenile movements within the KSA (1990-2009). All movements are included; internal, immigration, and emigration. A polynomial trendline is plotted. The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.



During 2009, there were a total of 66 sites where pairs were detected and nesting status was determined, 30 nested (45.5%) and 36 did not nest (54.5%). Of the sites where nesting occurred during 2009, 21 pairs successfully fledged young and 9 pairs nested and failed, resulting in a nesting success rate of 70.0% (Appendix C).

Table 1. Fecundity rate and mean brood size by age class within the KSA (1990-2009). Sites where backpack transmitters were attached to females during the nesting season were excluded from the calculation during the years of attachment. (a)

Age class	Mean fecundity (N), 1990-2009	95% CI for fecundity	Mean brood size (N), 1990-2009	95% CI for brood size
1-yr	0.065 (93)	0.017-0.112	1.71 (7)	1.35-2.08
2-yr	0.295 (134)	0.227-0.362	1.47 (53)	1.33-1.60
Adult	0.361 (1210)	0.336-0.385	1.59 (547)	1.55-1.63
Unk	0.244 (39)	0.136-0.351	1.27 (15)	1.04-1.50
Total	0.342		1.58	

(a) Preliminary data, values may change.

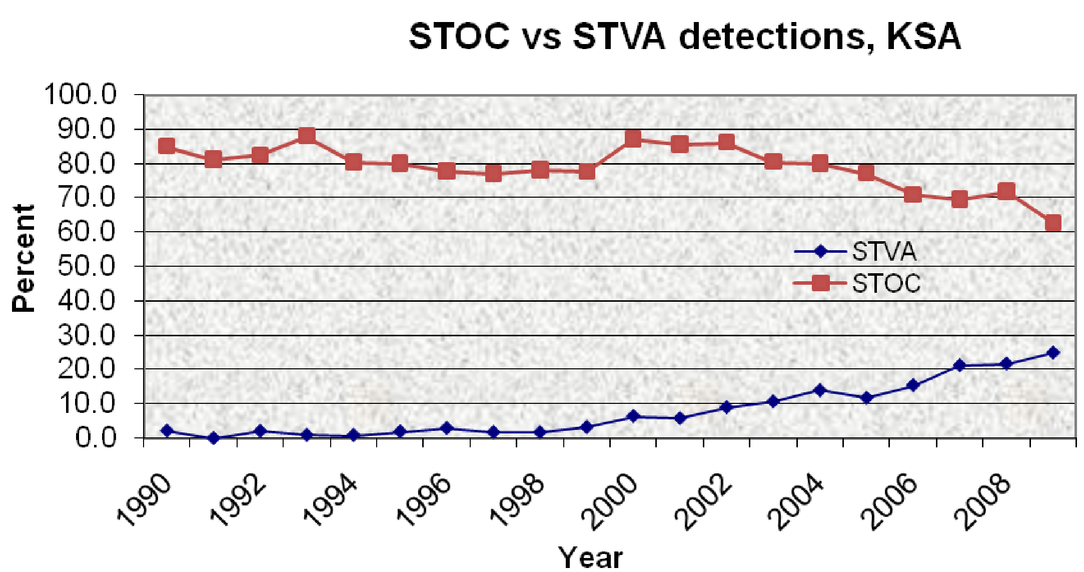
The fecundity rate for the entire KSA during 2009 was calculated at 0.244. The fecundity rate for 2009 within LSR boundaries was 0.181 and within non-LSR boundaries was 0.298. The fecundity rate for the years 1990-2009 was split into 4 female age classes. The rate for 1-year olds (0.065) was much lower than 2-year olds (0.295), adults (0.361), and unknown (0.244) (Table 1). None of the 3 pairs with a 1-year old female attempted to nest.

In 2009, the mean brood size (1.71) was higher than the average for the years 1990-2009 (1.58). The mean brood size for the years 1990-2009 was split into 4 female age classes, all resulted in similar values (Table 1).

Barred Owl

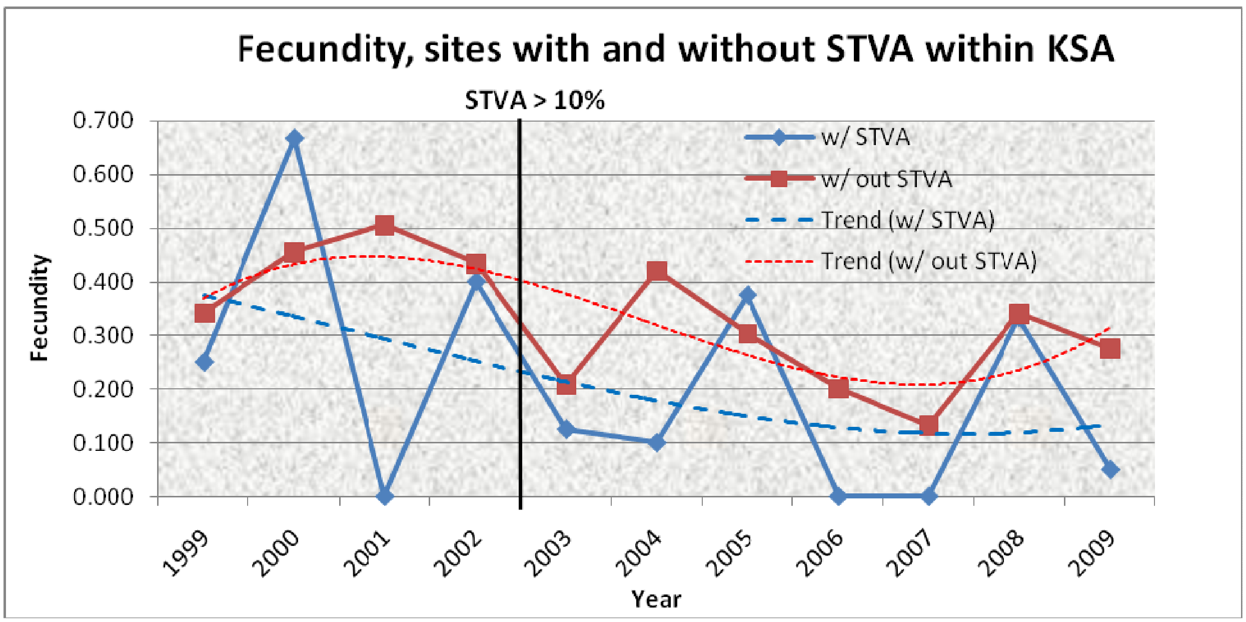
There were at least 58 non-juvenile barred owls (*Strix varia*) detected on the KSA during 2009. At 19 sites we detected a pair of barred owls and there was 1 known spotted-barred owl hybrid located within the KSA. At least 6 of these sites were known to have fledged young, the highest number documented on the KSA. A comparison was made of the percentage of sites that were surveyed where at least one spotted owl was detected versus at least one barred owl detected (Figure 3). The barred owl detections were incidental to spotted owl surveys, therefore the number of sites with at least one barred owl detection is probably underestimated. The percentage of sites surveyed for spotted owls with barred owl detections is trending upward from a relatively low 1.7% in 1998, to 10.7% in 2003, 21.8% in 2008, and 25.0% in 2009. The percentage of sites with a barred owl detection exceeded 10% for the first time during 2003, and has remained above 10% since.

Figure 3. Percentage of sites surveyed with at least one spotted owl detection versus sites with at least one barred owl detection. Klamath Study Area, 1990-2009.



The fecundity rate of spotted owls was compared between sites with barred owl detections and sites without known barred owl detections (Figure 4). These numbers should be viewed with caution since barred owl detections were incidental to survey efforts for spotted owls. The first year barred owls were detected at any spotted owl site where spotted owl reproduction was determined was in 1999. The fecundity rate for all data combined during the years 1999-2009 was 0.188 (0.096-0.279, N=56) for sites with barred owl presence, and 0.329 (0.301-0.357, N=870) for sites without known barred owl presence. The fecundity rate during 2009 was 0.050 (N=10) for sites with barred owl presence, and 0.276 (N=67) for sites without known barred owl presence. At sites with known barred owl presence during 2009, nesting attempts by spotted owls were 40.0% (N=10) of the sites with nest status determined, and nest success was 25.0% (N=4). At sites without known barred owl presence during 2009, nesting attempts were 41.8% (N=67) of the sites with nest status determined, and nest success was 76.9% (N=26).

Figure 4. Spotted owl fecundity rate at sites with and without known STVA detections (1999-2009). Polynomial trendlines are plotted. The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.



7. <u>Discussion for FY 2009</u>:

Survey Effort

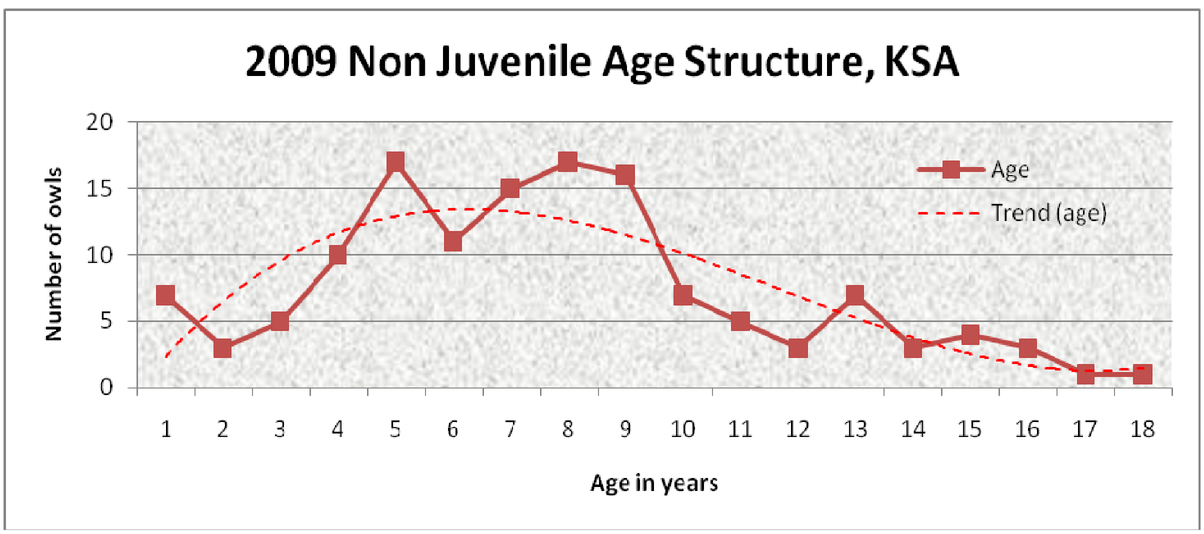
The survey effort within the KSA has varied over time, however the general trend has been an increase in the number of sites located and surveyed (Appendix A). The KSA boundaries were established in 1997 and the survey effort increased significantly at that time. The number of sites located within the KSA has remained relatively stable recently since much of the available habitat has been surveyed. Although most of the area within this boundary is covered by territorial surveys, it is not a density study and some area may still not be surveyed.

Spotted Owl Detections

The increase in individual spotted owl detections through 2002 corresponds with the increase in the number of sites surveyed on the KSA. The number of owls detected is no longer increasing rapidly as all possible owl sites were located, and has actually begun to decrease since the 2002 survey season. In recent years, there has been a steady decline in the total number of non-juveniles detected (Appendix B) and an even larger decrease in the number of pairs detected (Appendix A).

The decrease of the number of subadults is even more pronounced than the decrease of all non-juveniles combined. The highest proportion ever documented in the KSA (24.1% in 2002, 25.9% in 2003) occurred early in this decade and it has dropped to under 10% the past 5 years. This was the first time during the study that the proportion of subadults has remained under 10% for more than 2 consecutive years. Some of this may be explained by multiple years with low fecundity (1993, 1995, 2006, 2007) corresponding to subsequent years with low numbers of subadults recruited into the population. Another indicator of recruitment is the number of juveniles banded on the KSA surviving and being subsequently recaptured. The highest number of internal recruits was 20 in 2003 which was preceded by 3 consecutive years of very high fecundity rates. During 2009 there were 9 previously banded juveniles recaptured, compared to 5 in 2008, 17 in 2007, 9 in 2006, and 12 in 2005. This recent leveling or decrease in recruitment combined with the decrease in pair detection may be cause for concern.

Figure 5. Age structure during 2009 within the KSA. Only spotted owls with ages known within 1 year are included. A polynomial trendline is plotted.



A majority of the non-juvenile owls encountered for the first time (82.1% in 2007, 73.3% in

2008, 82.3% in 2009) were of known age or known within 1 year. Known age owls are a result of banding juveniles or locating new owls while they were still in the subadult age class. Knowing the age structure of the population allows flexibility for current and future analysis. Individuals of exact age were banded as juveniles, while those of approximate age were initially banded as subadults, and individuals of minimum age were initially banded as adults. Figure 5 illustrates the current age structure using only known or approximate age individuals. Most of the population is comprised of 4-8 year ages, which agrees with the results from Loschl (2008) whose data for an Oregon study showed that the average life span was 7-9 years.

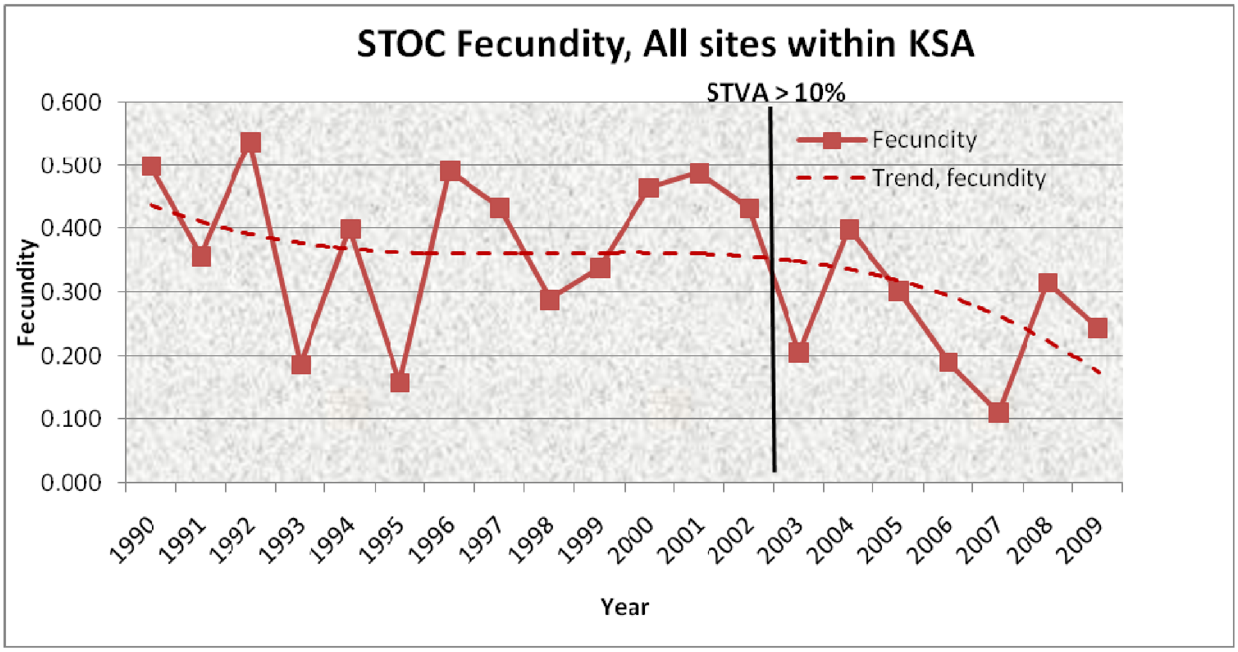
Spotted Owl Demographics

The nesting status was determined at 69 (88.5%) of the sites where reproduction was eventually determined. The last several years have had a consistently high rate of nest status determination (2007, 87.5%; 2008, 91.5%). Locating nesting pairs before 1 June is not required to determine reproduction, but it has several benefits. One benefit is a more accurate determination of nest success, which is the number of pairs that attempted to nest and actually fledged young. Another benefit is a more accurate count of the number of young fledged. If the nest tree location is known, reproductive visits can be timed soon after fledging occurs to avoid the effects of early juvenile mortality which would lead to the undercounting of nesting success.

The nest success rate for 2009 was 68% and compares to the average of 76% from 1990-2009 (Appendix C). Five of the previous 7 years (2003-2009) have had a lower than average nest success rate, the reasons are unknown. In contrast, the 2009 mean brood size was 1.71 and was higher than the average for all years of 1.58 (Appendix C). Four of the previous 7 years (2003-2009) had a higher brood size than the average for all years and may partially offset the lower nest success during that time period.

The fecundity rate for 2009 was 0.244, and was lower than the average for the years 1990-2009 (0.342) (Figure 6). While the fecundity rate is known to fluctuate, we documented only 1 year during the most recent 7 years where the fecundity rate was above the overall average. In addition, the number of pairs at sites has declined during that same time period, and the number of unoccupied sites has increased. The number of sites surveyed during this period has remained relatively constant. We documented a gradually increasing fecundity rate from 1-year old to adult age classes. Our most recent analysis shows a very low fecundity rate for 1-year olds, while the rate for 2-year olds was similar to, but lower than the adult rate (Table 1). This follows the trend that Loschl (2008) reported for data from a study area in the Oregon Coast Range, where the mean annual number of young fledged increased at a constant rate from 1-year old through 4-year olds, then remained constant. Loschl noted that using only 3 age classes misses some of the variation in the older ages. We may want to consider future analysis using actual ages to determine if the trend Loschl noted also occurs within the KSA. Although fecundity rates varied by age class, the mean brood sizes did not appear to differ greatly among age classes. The number of juveniles detected within the KSA during 2009 (38) was lower than the overall median (Appendix B). Only 2 of the previous 7 years had fewer juveniles detected, and the 7 years previous to that period all had higher numbers. These higher numbers occurred even though there were fewer sites surveyed during those years. The nest success, fecundity rate, and mean brood size for the early years (1985-1989) were calculated from small sample sizes and preceeded a standardized protocol, therefore results from those years may not be comparable to more recent data.

Figure 6. Spotted owl fecundity at all sites surveyed, KSA 1990-2009. A polynomial trendline is plotted. The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.



The yearly fecundity rates for sites within an LSR compared to sites outside the LSR boundary are given in Appendix D. The NWFP became effective in the spring of 1994. Data presented here are for the combined years before and after the effective date. Fecundity rates at LSR sites compared to non-LSR sites both before and after the NWFP implementation indicate similar rates. There was a slight decrease in fecundity after the NWFP implementation for both LSR (0.407 versus 0.315) and non-LSR (0.386 versus 0.330) sites. During the previous 5 years, fecundity has been higher at non-LSR sites. The fecundity rate during 1990-2009 was slightly lower at LSR sites than at non-LSR sites. In recent years, the number of sites where fecundity was determined has decreased on both LSR and non-LSR sites, indicating there may be a population decline in both. Currently the harvest level on federal non-LSR forest is quite minimal. In addition, the private land harvest has occurred at about the same rate both inside and outside the LSR boundary. The differences may be more meaningful as more timber is harvested from non-LSR federal land.

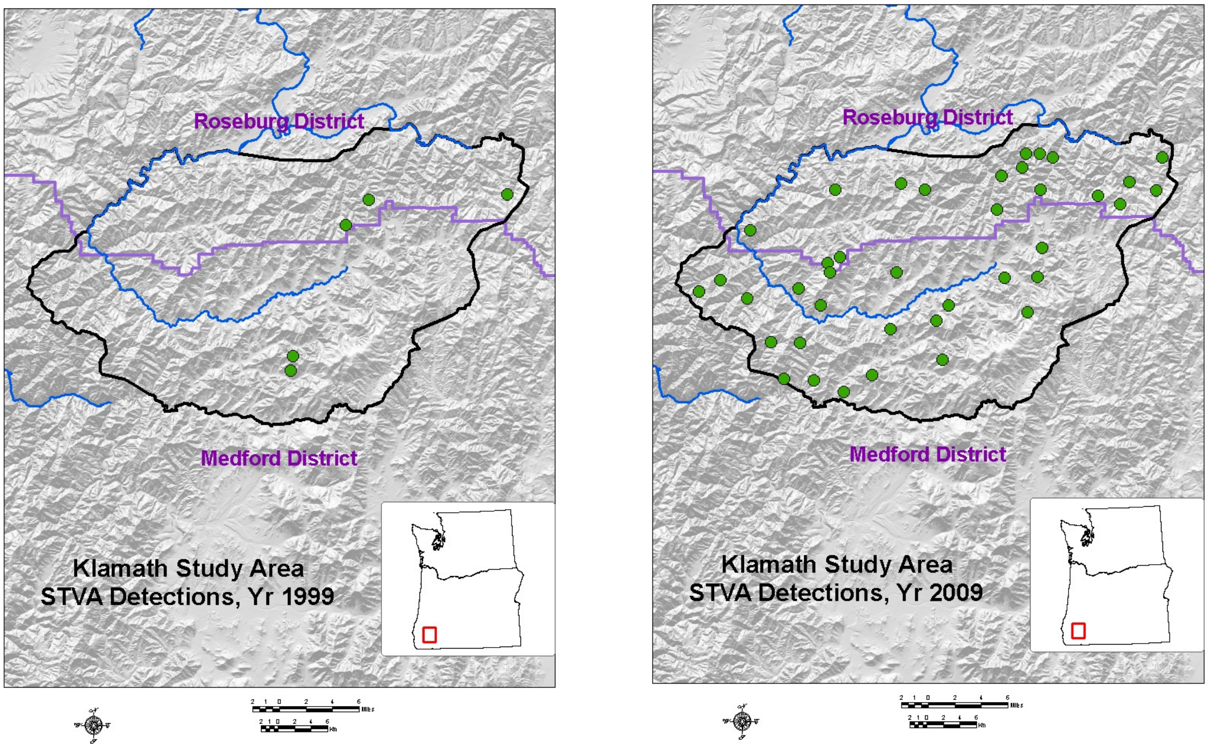
Barred Owl

The decrease in spotted owl detections since 2002 corresponds to an increase in barred owl presence (Figure 3). It has been shown (Bailey et al. 2009, Crozier 2006) that the presence of barred owls negatively affects the detection probabilities of spotted owls. This may account for some of the decrease in spotted owl detections, however it is quite possible the barred owl is actually having an impact on the population. It has been shown (Olson et al. 2005) that barred owl presence had a positive effect on local-extinction probabilities or a negative effect on colonization probabilities of sites by spotted owls. They concluded that further declines in the proportion of sites occupied by spotted owls is expected, and the population on the KSA may be experiencing these effects.

The 58 non-juvenile barred owls detected on the KSA was higher than the number detected in 2007 (46) and 2008 (44), and was the highest number detected during any previous year. Using simple presence at a site, there was a proportional increase in the number of sites with barred owl detections during the last few years. Beginning in 2003, barred owl's were detected at more than 10% of the sites surveyed in each subsequent year, and never exceeded 10% in any previous year (Figure 3). During 2009, the percentage of sites where barred owl's were detected was the highest of any year, and the percentage of sites where spotted owl's were detected was the lowest of any year. Barred owl detection may be less likely to occur at sites occupied by spotted owls. These sites tend to receive more focused diurnal visits and less complete coverage of the territory compared to unoccupied sites which are thoroughly surveyed with at least 3 nights. Therefore, the number of sites with at least one barred owl detection probably underestimates the actual number of barred owls present, especially at sites with spotted owl detections. Figure 7 illustrates the change in known barred owl site occupation comparing 1999 to 2009.

There has been a rapid increase in barred owl detections at the Tyee Density study area north of the KSA (Forsman et al 2009). On the Tyee Density study, the number of sites with barred owl detections exceeded the number of sites with spotted owl detections for the first time in 2009. The percent of sites where barred owls were detected has exceeded 50% during the past 3 years and had never exceeded 50% previous to that time. The graph in Figure 3 appears similar to the Tyee data through 2002, indicating the barred owls will continue to increase in the KSA as well. It is probable that barred owls will continue their expansion south affecting spotted owl detections and population trends (Kelly 2001). It has been postulated that the spotted owl population will experience internal movements in reaction to barred owl disruption of territories. Data on the number of non-juvenile movements within the study were fairly consistent over recent time, 17 in 2009, 17 in 2008, 20 in 2007, and 14 in 2006. Earlier years previous to barred owl detections resulted in fewer movements, 5 in 1995, 16 in 1994, 5 in 1993, and 6 in 1992. These earlier years had about 32% fewer sites surveyed, therefore the numbers are not directly comparable but do show a trend. Data on the distance of adult movements (Figure 2) indicates a slight upward trend in recent years. This indicates major disruption may not have occurred yet, but the level of barred owl presence seems to be increasing and the trends suggest some influence on movements.

Figure 7. Barred owl detections on the KSA, 1999 and 2009. Green dots represent a site with at least a single barred owl detection during the year.



We compared fecundity rates at sites with and without barred owl detections from 1999-2009. Because barred owl detections were incidental, the results at sites where spotted owl reproduction was determined may be biased low regarding barred owl detections. However, any survey bias for reproductive versus non reproductive sites should be somewhat similar since most visits occur diurnally. The fecundity rate from 1999-2009 at sites with known barred owl presence was 0.188 compared to 0.329 at sites where barred owls were not detected. There was no overlap in confidence intervals for these estimates. During this time, the fecundity rate was higher in 2 of 11 years at sites with known barred owl presence versus sites with no known barred owl detections, but one of those 2 years (2000) had a very small sample size. The fecundity rate using only the 2009 data at sites with known barred owl presence was 0.050 compared to 0.276 at sites where barred owls were not detected. These individual and cumulative year data indicate barred owl presence may have a negative impact on spotted owl reproduction and agree with findings from Olson et al 2004.

There is mounting evidence that barred owls are having a negative impact on the spotted owl population within the KSA. This is illustrated by several population trends beginning about 2003 which is when barred owl detections at sites within the KSA exceed 10%. Spotted owl detections have been steadily decreasing since 2002 (Figure 3) and reached the lowest point in 2009, the same year barred owl detections reached their highest level.

Fecundity rates at all sites appear to be declining (Figure 6) during the past 7 years and in only 1 of those 7 years was the rate above average. In addition, there is evidence that the fecundity rates at sites with known barred owl presence is lower than at other sites. If these trends continue, a combination of lower occupancy and reduced fecundity, there may be cause for concern regarding the spotted owl population.

8. Acknowledgments:

Many people and organizations contributed to the success of this project. Without the dozens of dedicated people collecting the field data, none of this could have been accomplished. In addition, biologists from surrounding areas have contributed information regarding owl movements. Several private timber companies have been gracious enough to allow access to sites on their property. The primary government agencies with land owned or administered within the Klamath Study Area are the BLM and the State of Oregon. Funding for rangewide demographic studies comes from BLM, USDA Forest Service, and the National Park Service.

9. Literature Cited:

Anthony, R., G. Olson, E. Forsman, J. Reid, P. Loschl, W. Ripple, E. Glenn, and K. Harkins. 2000. Predicting Abundance and Demographic Performance of Northern Spotted Owls from Vegetative Characteristics. Report on Phase I: Evaluation of Different Methods for Habitat Mapping. 100pp.

Anthony, R., E. Forsman, A. Franklin, D. Anderson, K. Burnham, G. White, C. Schwartz, J. Nichols, J. Hines, G. Olson, S. Ackers, S. Andrews, B. Biswell, P. Carlson, L. Diller, K. Dugger, K. Fehring, T. Fleming, R. Gerhardt, S. Gremel, R. Gutierrez, P. Happe, D. Herter, J. Higley, R. Horn, L. Irwin, P. Loschl, J. Reid, and S. Sovern. 2006. Status and Trends in Demography of Northern Spotted Owls, 1985-2003. Wildlife Monograph No. 163.

Bailey, L.L., J.A. Reid, E.D. Forsman, and J.D. Nichols. 2009. Modeling co-occurrence of northern spotted and barred owls: Accounting for detection probability differences. Biological Conservation. 142:2983-2989.

Burnham, K.P., D.R. Anderson, and G.C. White. 1996. Meta-Analysis of vital rates of the northern spotted owl. Studies in Avian Biology 17:92-101.

Crozier, M.L., M.E. Seamans, R.J. Gutierrez, P.J. Loschl, R.B. Horn, S.G. Sovern, and E.D. Forsman. 2006. Does the presence of barred owls suppress the calling behavior of spotted owls? The Condor. 108:760-769.

Franklin, A.B., K.P. Burnham, G.C. White, R.G. Anthony, E.D. Forsman, C. Schwarz, J.D. Nichols, and J. Hines. 1999. Range-wide status and trends in northern spotted owl populations. Colorado Cooperative Wildlife Research Unit, Colorado State University, Fort Collins, Colorado, USA and Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis, Oregon, USA. 71pp.

Franklin, J.F., and C.T. Dyrness. 1973. Natural Vegetation of Oregon and Washington. U.S. Department of Agriculture - Forest Service. Gen. Tech. Rpt. PNW-GTR-8.

Forsman, E.D., R.G. Anthony, J.A. Reid, P.J. Loschl, S.G. Sovern, M. Taylor, B.L. Biswell, A. Ellingson, E.C. Meslow, G.S. Miller, K.A. Swindle, J.A. Thrailkill, F.F. Wagner, and D.E. Seaman. 2002. Natal and Breeding Dispersal of Northern Spotted Owls. Wildlife Monograph No.149.

Forsman, E. D., J.A. Reid, J.S. Mowdy, J.D. Baldwin, and A.L. Price. 2009. Demographic characteristics of northern spotted owls (Strix occidentalis) on the Tyee Density Study Area, Roseburg, Oregon: 1985-2009. Annual Report. 19p.

Forsman, E. D., et al. (in press). Population Demography of Northern Spotted Owls: 1985-2008. Studies in Avian Biology.

Kelly, E. G. 2001. The Range Expansion of the Northern Barred Owl: An Evaluation of the Impact on Spotted Owls [thesis]. Corvallis, OR: Oregon State University. 78p.

Olson, G. S., E.M. Glenn, R.G. Anthony, E.D. Forsman, J.A. Reid, P.J. Loschl, and W.L. Ripple. 2004. Modeling Demographic Performance of Northern Spotted Owls Relative to Forest Habitat in Oregon. Journal of Wildlife Management 68:1039-1053.

Olson, G. S., R.G. Anthony, E.D. Forsman, S.H. Ackers, P.J. Loschl, J.A. Reid, K.M. Dugger, and W.J. Ripple. 2005. Modeling of Site Occupancy of Northern Spotted Owls, with Emphasis on the Effects of Barred Owls. Journal of Wildlife Management 69:918-932.

Lint, J.B., B.R. Noon, R.G. Anthony, E.D. Forsman, M.G. Raphael, M. I. Collopy and E.E. Starkey. 1999. Northern spotted owl effectiveness monitoring plan for the Northwest Forest Plan. U.S. Department of Agriculture - Forest Service. Gen. Tech. Rpt. PNW-GTR-444. 43pp.

Loschl, P.J. 2008. Age-specific and Lifetime Reproductive Success of Known Age Northern Spotted Owls on Four Study Areas in Oregon and Washington [thesis]. Corvallis, OR: Oregon State University. 141p.

USDA and USDI. 1994. Final supplemental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. 2 volumes. U. S. Department of Agriculture - Forest Service and U.S. Department of Interior - Bureau of Land Management, Portland, Oregon, USA.

Appendix A. Territories surveyed and occupancy results by year within the KSA (1985-2009). (a)

Year	Total Sites (b)	Sites w/ STVA (c)	Sites w/ Pair (d)	Sites w/ single	Sites w/ undetermined status (e)	Total occupied sites	Sites w/ no occupation (f)	Sites w/ incomplete survey (g)
1985	9	0	6	1	1	8	1	0
1986	17	0	13	2	1	16	1	0
1987	34	0	24	3	4	31	3	3
1988	42	0	30	3	5	38	4	7
1989	62	1	39	8	9	56	5	5
1990	93	2	58	10	11	79	14	7
1991	95	0	61	11	5	77	18	11
1992*	97	2	58	13	9	80	17	11
1993*	107	1	66	15	13	94	13	9
1994*	112	1	73	4	13	90	22	9
1995*	105	2	60	11	13	84	18	17
1996	103	3	58	7	15	80	21	19
1997	117	2	61	12	17	90	25	9
1998*	119	2	74	9	10	93	22	11
1999*	125	4	74	9	14	97	25	7
2000*	124	8	71	16	21	108	12	9
2001*	138	8	86	12	16	118	20	1
2002	144	13	96	10	18	124	16	1
2003	149	16	95	11	14	120	21	0
2004	150	21	96	10	14	120	26	0
2005	153	18	91	13	14	118	31	1
2006	155	24	89	10	11	110	36	1
2007	155	33	81	16	11	108	38	1
2008	156	34	79	13	20	112	36	0
2009	156	39	75	9	14	98	52	0

(a) Preliminary data, values may change.
(b) Sites surveyed to protocol. The sum of the last 3 columns may not equal the total sites since sites with the same individual located at 2 sites are not considered as occupied at one site.
(c) STVA occupancy is opportunistic and is defined as any detection at the site.
(d) Pair as defined in Lint et al 1999.
(e) Undetermined status may include one or 2 owls, does not qualify as a pair or single.
(f) No occupancy determined with at least 3 survey visits.
(g) Incomplete survey is 2 visits or less (usually no visits, only includes sites surveyed in previous years).
* represents years with a site where the pair was comprised of a spotted owl and a barred owl which was included as a “site with single”.

Appendix B. Sex and age composition of spotted owls located within the KSA (1985-2009). Non-juvenile owls where the sex could not be determined are not included. (a)

Year	Adult (M,F)	Subadult (M,F)	Percent Subadult	Age unk (M,F) (b)	Total non-juvenile (M,F)	Juvenile
1985	10 (6,4)	0 (0,0)	0.0	5 (2,3)	15 (8,7)	6
1986	17 (10,7)	1 (1,0)	5.6	10 (4,6)	28 (15,13)	18
1987	32 (19,13)	9 (5,4)	22.0	16 (6,10)	57 (30,27)	8
1988	43 (26,17)	12 (4,8)	21.8	13 (7,6)	68 (37,31)	17
1989	76 (42,34)	6 (3,3)	7.3	18 (10,8)	100 (55,45)	18
1990	100 (56,44)	14 (8,6)	12.3	22 (12,10)	136 (76,60)	52
1991	112 (61,51)	16 (7,9)	12.5	14 (8,6)	142 (76,66)	40
1992	106 (61,45)	16 (6,10)	13.1	18 (11,7)	140 (78,62)	59
1993	117 (63,54)	23 (12,11)	16.4	23 (16,7)	163 (91,72)	22
1994	125 (67,58)	28 (13,15)	18.3	15 (8,7)	168 (88,80)	55
1995	118 (65,53)	9 (1,8)	7.1	20 (15,5)	147 (81,66)	18
1996	112 (61,51)	8 (4,4)	6.7	26 (14,12)	146 (79,67)	56
1997	114 (59,55)	22 (15,7)	16.2	26 (12,14)	162 (86,76)	52
1998	124 (67,57)	27 (14,13)	17.9	19 (9,10)	170 (90,80)	41
1999	131 (72,59)	16 (5,11)	10.9	31 (16,15)	178 (93,85)	44
2000	135 (74,61)	18 (9,9)	11.8	32 (19,13)	185 (102,83)	65
2001	148 (77,71)	34 (19,15)	18.7	18 (13,5)	200 (109,91)	82
2002	154 (84,70)	49 (21,28)	24.1	19 (13,6)	222 (118,104)	83
2003	152 (84,68)	53 (25,28)	25.9	12 (8,4)	217 (117,100)	38
2004	173 (93,80)	28 (11,17)	13.9	18 (13,5)	216 (115,101)	75
2005	192 (105,87)	17 (3,14)	8.2	6 (6,0)	215 (114,101)	61
2006	168 (91,77)	18 (3,15)	9.7	14 (10,4)	200 (104,96)	35
2007	159 (82,77)	16 (7,9)	9.1	14 (9,5)	189 (98,91)	19
2008	163 (83,80)	11 (4,7)	6.3	19 (12,7)	193 (99,94)	53
2009	147 (75,72)	8 (5,3)	5.2	14 (12,2)	169 (92,77)	38

(a) Preliminary data, values may change.
(b) It is possible some of the unknown are auditory responses and the same individuals as included in another category.

Appendix C. Fecundity rate and mean brood size by year within the KSA (1985-2009). Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. (a)

Year	Nest success (N)	95% CI for Nest Success	Mean fecundity (N)	95% CI for fecundity	Mean brood size (N)	95% CI for brood size
1985	1.00 (4)	NA**	0.750 (4)	0.467-1.033	1.50 (4)	0.93-2.07
1986	1.00 (6) (64)	NA**	0.813 (8)	0.555-1.070	1.86 (7)	1.58-2.14
1987*	1.00 (4)	NA**	0.286 (14)	0.063-0.509	1.60 (5)	1.12-2.08
1988*	1.00 (12)	NA**	0.472 (18)	0.287-0.658	1.42 (12)	1.13-1.71
1989*	0.75 (8)	0.43-1.07	0.296 (27)	0.146-0.447	1.45 (11)	1.15-1.76
1990*	0.75 (28)	0.59-0.91	0.500 (48)	0.376-0.624	1.60 (30)	1.42-1.78
1991*	0.70 (30)	0.53-0.87	0.357 (56)	0.238-0.476	1.67 (24)	1.44-1.89
1992*	0.87 (31)	0.75-0.99	0.538 (52)	0.422-0.655	1.51 (37)	1.32-1.71
1993	0.75 (16)	0.53-0.97	0.186 (59)	0.098-0.275	1.47 (15)	1.21-1.73
1994	0.81 (31)	0.67-0.95	0.400 (70)	0.288-0.512	1.81 (31)	1.64-1.97
1995	0.67 (18)	0.44-0.89	0.158 (57)	0.076-0.240	1.38 (13)	1.11-1.66
1996	0.84 (32)	0.72-0.97	0.491 (57)	0.386-0.597	1.47 (38)	1.31-1.63
1997	0.96 (27)	0.89-1.04	0.433 (60)	0.316-0.551	1.73 (30)	1.57-1.89
1998	0.63 (32)	0.45-0.80	0.289 (71)	0.202-0.376	1.37 (30)	1.19-1.54
1999	0.88 (25)	0.75-1.01	0.338 (65)	0.231-0.446	1.69 (26)	1.51-1.87
2000	0.84 (45)	0.74-0.95	0.464 (70)	0.366-0.563	1.51 (43)	1.36-1.66
2001	0.85 (53)	0.75-0.95	0.488 (84)	0.387-0.589	1.78 (46)	1.66-1.90
2002	0.85 (60)	0.76-0.94	0.432 (96)	0.344-0.520	1.60 (52)	1.46-1.73
2003	0.60 (42)	0.44-0.75	0.205 (95)	0.137-0.273	1.34 (29)	1.17-1.52
2004	0.85 (54)	0.76-0.95	0.399 (94)	0.312-0.486	1.56 (48)	1.42-1.70
2005	0.62 (53)	0.49-0.75	0.302 (101)	0.220-0.384	1.60 (38)	1.45-1.76
2006	0.61 (33)	0.44-0.78	0.190 (92)	0.116-0.264	1.59 (22)	1.38-1.80
2007	0.69 (16)	0.45-0.92	0.110 (87)	0.047-0.174	1.73 (11)	1.45-2.00
2008	0.80 (45)	0.68-0.93	0.315 (84)	0.231-0.400	1.43 (37)	1.27-1.59
2009	0.70 (30)	0.51-0.84	0.244 (78)	0.153-0.334	1.71 (21)	1.52-1.91
1990-2009	**0.76**		**0.342**		**1.58**	

(a) Preliminary data, values may change.

Appendix D. Fecundity rate and mean brood size by Land Use Allocation and year within the KSA. Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. (a)

Year	LSR, Mean fecundity (N)	LSR, 95% CI for fecundity	Non-LSR, Mean fecundity (N)	Non-LSR, 95% CI for fecundity
1985	0.667 (3)	0.340-0.993		
1986	0.700 (5)	0.308-1.092		
1987*	0.273 (11)	0.030-0.515	0.333 (3)	0.000-0.987
1988*	0.409 (11)	0.187-0.631	0.571 (7)	0.238-0.905
1989*	0.324 (17)	0.119-0.528	0.250 (10)	0.031-0.469
1990*	0.462 (26)	0.290-0.633	0.545 (22)	0.364-0.727
1991*	0.411 (28)	0.243-0.578	0.304 (28)	0.134-0.473
1992*	0.589 (28)	0.422-0.757	0.479 (24)	0.318-0.640
1993	0.214 (28)	0.077-0.352	0.161 (31)	0.046-0.276
1994	0.357 (35)	0.194-0.521	0.443 (35)	0.288-0.597
1995	0.145 (31)	0.032-0.258	0.173 (26)	0.052-0.294
1996	0.500 (32)	0.361-0.639	0.480 (25)	0.315-0.645
1997	0.533 (30)	0.371-0.696	0.333 (30)	0.168-0.498
1998	0.303 (33)	0.183-0.423	0.276 (38)	0.150-0.403
1999	0.333 (33)	0.176-0.491	0.344 (32)	0.195-0.493
2000	0.444 (36)	0.305-0.584	0.485 (34)	0.345-0.626
2001	0.500 (43)	0.362-0.638	0.476 (41)	0.327-0.625
2002	0.489 (46)	0.358-0.620	0.380 (50)	0.263-0.497
2003	0.196 (46)	0.092-0.299	0.214 (49)	0.124-0.305
2004	0.409 (44)	0.273-0.545	0.390 (50)	0.277-0.503
2005	0.211 (45)	0.106-0.317	0.375 (56)	0.257-0.493
2006	0.115 (39)	0.024-0.207	0.245 (53)	0.138-0.353
2007	0.053 (38)	0.000-0.125	0.156 (49)	0.060-0.253
2008	0.311(37)	0.189-0.433	0.319(47)	0.202-0.436
2009	0.181 (36)	0.056-0.305	0.298 (42)	0.168-0.427
1990-1994	**0.407**		**0.386**	
1995-2008	**0.315**		**0.330**	
1990-2008	**0.338**		**0.344**	

(a) Preliminary data, values may change.